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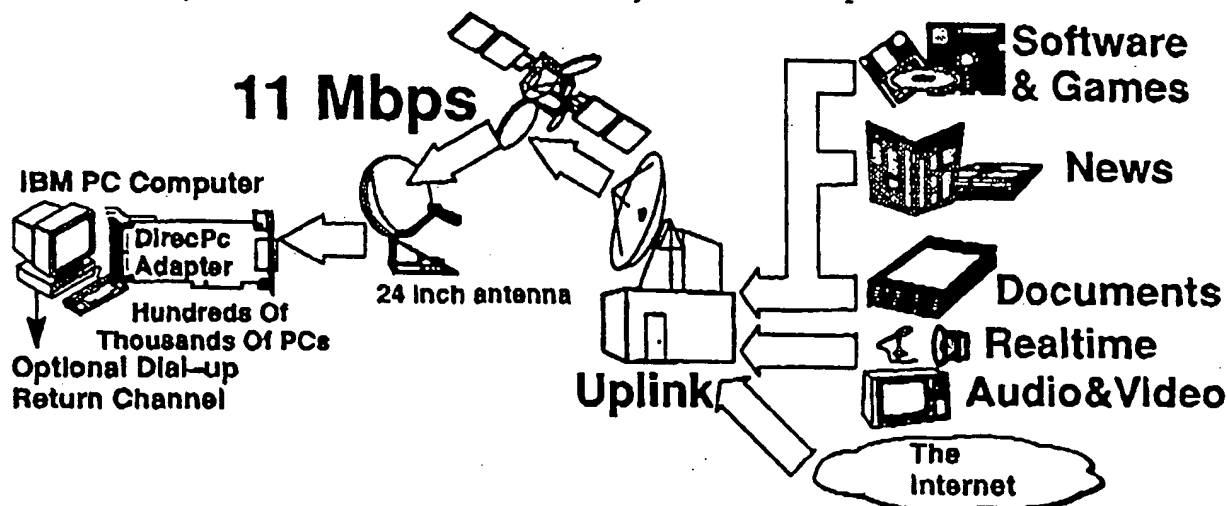
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Appendix

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DirecPC is a satellite, one-way broadcast network offering three services to the IBM compatible PC:

1. Digital package delivery – Software, games, multi-media news, electronic documents and any other data in the form of a collection of PC files are made available to the PC on a scheduled or on-demand basis.
2. Data Pipe – provides multiple independent digital streams to carry video, audio, etc.
3. Hybrid Internet Access – high-speed, low-cost Internet connection where DirecPC carries packets from the Internet and dial-up modem carries packets into the Internet.



To receive the DirecPC broadcast, a PC is equipped with a PC plug-in card and a 24 inch antenna. DirecPC uses a full Galaxy class Ku-Band transponder to provide an 11 Mbps broadcast channel. DES encryption based conditional access ensures that a receiver PC may only access data it is authorized to receive.

Section 1 PC User Perspective

The PC hardware consists of the DirecPC adapter, an antenna and a TVRO standard coaxial cable. The DirecPC adapter is a 16-bit ISA adapter providing throughput comparable to a 16-bit ISA ethernet adapter.

The software appears to the user as a set of Windows applications. The applications:

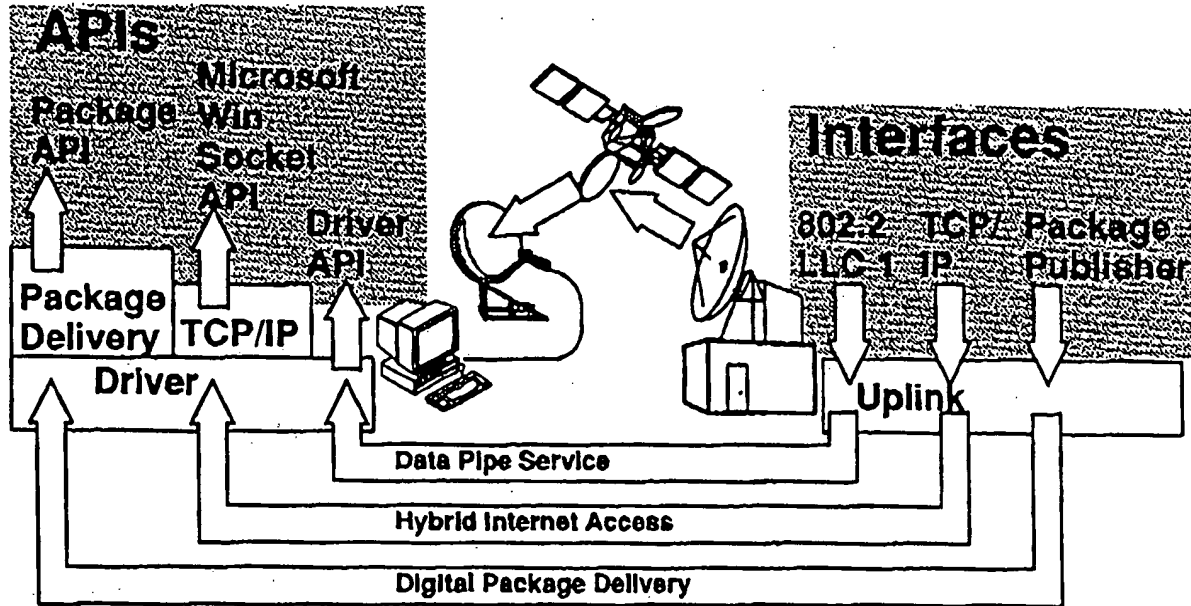
- assist installation and service registration.
- support package delivery by allowing the user to select packages for reception, be notified when packages are received. The software also supports billing for packages received.
- provide a TCP/IP protocol stack and set of applications for Hybrid Internet access.
- provide a driver DLL on which third party software may layer data pipe applications.

The software for a data pipe service is provided by the enterprise providing the service.

Communications back to the uplink is required for billing purposes and also for Hybrid Internet access. This communications takes place via the PC's dial-up AT command-set modem.

Section 2 Open Interfaces And APIs

The DiracPC architecture is open, allowing content providers complete control over their content and the user interface to their content. DiracPC provides interfaces to content providers at the uplink and Application Programming Interfaces (APIs) on the receiving PC. The specifications and APIs are available on request.



Section 3 Content Providers

A content provider is an organization that supplies the data sent over the DiracPC system. A content provider can be categorized as being either a:

1. Package Publisher – uses the DiracPC system as a means of selling and distributing software packages or data packages where a package consists of a set of PC files.
2. Data Pipe Provider – uses the DiracPC system as a data pipe transport mechanism. User services (News Feeds, Internet Access, Broadcast Video and Audio, etc.) are layered on top of a datagram transport.

DiracPC supports multiple content providers of both kinds.

Section 4 DiracPC Package Distribution

The DiracPC system allows data packages to be distributed and purchased. The term "package" refers to any data (including electronic documents, multi-media data, software packages, games, etc.) which can take the form of a group of PC files.

To prepare a package for transmission, a publisher merges the package's files into a single file using the appropriate utility (e.g. PKZIP or ARJ) and loads the package into the uplink using an off-the-shelf file transfer mechanism (e.g. TCP/IP's FTP, floppy-disk, CD-ROM, X-Modem, etc.). Scheduling, pricing and conditional access restrictions can be performed either manually or automatically under publisher control when the package is loaded into the uplink.

DirecPc's conditional access mechanism ensures that a user may only receive authorized packages. As part of initial registration, the user is provided a credit limit. The PC locally maintains a credit account. When the user selects a package for reception, the PC records the transaction and debits the account. A log of all package receptions is maintained on the PC's hard disk and can be browsed by the graphical front-end.

On uplink operator command, when the local credit limit is exceeded or when the user has purchased a certain number of packages, the PC makes a dial-up call to the DirecPc billing service. The call reports the billing information as well as usage information of packages received.

The usage information is used to provide feedback for future scheduling of packages. The reports given to publishers include, for each package reception, the name, address etc. of the recipient, the ID of the package and when package delivery took place.

A software package may either be transmitted on a scheduled basis or on-demand. Scheduled transfers are perfect for:

1. Periodical Distribution – examples include news and weather updates, electronic newspaper, magazine and catalog distribution.
2. Popular Package Delivery – packages for which there are expected to be multiple recipients. The most popular (or highest profit) packages would be scheduled more frequently to reduce the average time spent waiting, while less popular packages may be scheduled for overnight delivery. Scheduled delivery is lower cost than delivering a package on-request to each buyer. The schedule for individual packages is manually set by hub operators with the submission of the package.

Phase A package delivery allows a single transmission at any given time. The rate of transmission is settable under operator control at speeds up to 2 Mbits/sec. Support for simultaneous transmissions will be provided in a subsequent release of DirecPc software.

A software package may be transmitted on-demand in the gaps between scheduled transmissions. Such a transfer delivers the information more quickly to the requesting PC, but at greater cost as the package is not broadcast. A PC uses its modem to request the package.

DirecPc's low bit error rate and high availability ensure that packages are reliably delivered with one transmission. For even greater reliability, each package may be set to employ one or more of the following methods to ensure fail-safe delivery:

1. Repeated Transmission – A package may be scheduled to be sent more than once to ensure its delivery. A receiving PC, if any packets are lost on the first transmission, fills in the gaps on subsequent transmissions. This mechanism ensures extremely high probability of delivery without requiring use of a return link.
2. Retransmission requests – a PC, if it misses parts of a package, may request retransmission of those parts. The missing parts are multi-cast so that parts need only be retransmitted once even though they were missed by multiple PCs. Retransmission requests are most appropriate for scheduled individual package transmissions where the package is scheduled less frequently.
3. Delivery confirmation – a PC, after successfully receiving and installing a package, may send a confirmation to the hub. These confirmations are tabulated and provided in the form of reports to the publisher. This method is more expensive in that it requires that a delivery confirmation (entailing a separate call) be sent by every receiving PC.

Section 5 Data Pipe Transmission

DirecPc's data pipe services are modelled on Local Area Network multi-cast transmission. The data pipe provider passes 802.2 LLC1 Token-Ring or Ethernet multi-cast packets to the uplink. This allows off-the-shelf bridges and routers to be used to support a terrestrial backhaul. It also allows some LAN based applications to operate across the spacelink with little or no modification. The uplink relays these packets across the spacelink. The DirecPc driver passes received packets to the applications. To prevent unauthorized access, each multi-cast address is encrypted under a different key. The DirecPc device driver API allows applications to designate which multi-cast addresses are of interest. Hardware filtering in the DirecPc adapter allows the reception of any 100 different multi-cast addresses.

DirecPc network management allocates to each service provider:

1. a Committed Information Rate (CIR) – a fraction of broadcast channel bandwidth which is guaranteed to the data pipe provider, and
2. one or more multi-cast 48 bit addresses – each address operates as a separate data stream multiplexed on the one broadcast channel.

Section 6 Hybrid Internet Access

Hybrid Internet access allows a PC high-speed (over 100 Kbps) access to the Internet. An HNS provided NDIS device driver operates with an off-the-shelf TCP/IP package. Reception from the Internet takes place via DirecPc. Transmission into the Internet takes place via a dial-up SLIP connection into the uplink. Hybrid Internet Access allows operation of all the standard Internet applications including SMTP EMAIL, NNTP Usenet News, FTP, GOPHER and Mosaic. As part of initial registration, each receiving PC is provided a permanently assigned IP address.

Hybrid Internet Access is the result of joint development by HNS and the University Of Maryland funded in part by a MIPs grant. Continuing development will increase performance and allow receive-only reception of Usenet News.

Section 7 Performance Specifications

Averaged across a whole year, each DirecPc receiver should be expected to have a BER less than $10E-10$ more than 99.5% of the time where a single bit error causes the loss of an entire packet.

Section 8 User Characteristics

The receiver (antenna, cabling and PC plug-in card) is intended to be self-installable by consumers and small business. In cases where self-installation is not desirable, the DirecPc adapter will be installed by the customer and the antenna and cable will be installed by the HNS VSAT installers. The customer uses diagnostic software provided with the adapter to ensure that the PC as a whole is ready for the antenna to be installed.

Maintenance will be performed either by the user swapping components (DirecPc adapter, LNB, etc with telephone support). HNS's nationwide VSAT field-service network may also be contracted for.